APPENDIX F

Non-Native Invasive (Weed) Management Plan for the Hallelujah Junction Wildlife Area

PREPARED FOR
California Department of Fish and Game, North Central Region

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NON-NATIVE INVASIVE (WEED) MANAGEMENT PLAN FOR THE HALLELUJAH JUNCTION WILDLIFE AREA

CONTENTS

APPENDICES

1.0 INTRODUCTION

This plan provides a preliminary strategy for managing the highest priority invasive non-native plants at Hallelujah Junction Wildlife Area (HJWA). It includes information on non-native plants identified to date on wildlife area lands, the relative threats posed by those species, and considerations that should be taken when prioritizing species for management. The plan also includes an initial list of the highest priority species, but this list should be used only as a first cut; additional information will be required before a final priority list can be developed. This required information includes, but is not limited to, the following:

- detailed maps of individual occurrences of the species,
- density of the plants within those occurrences,
- potential for the species to spread,
- the proximity of the occurrences to water, and
- the proximity of the occurrences to special-status plant or wildlife populations or habitat.

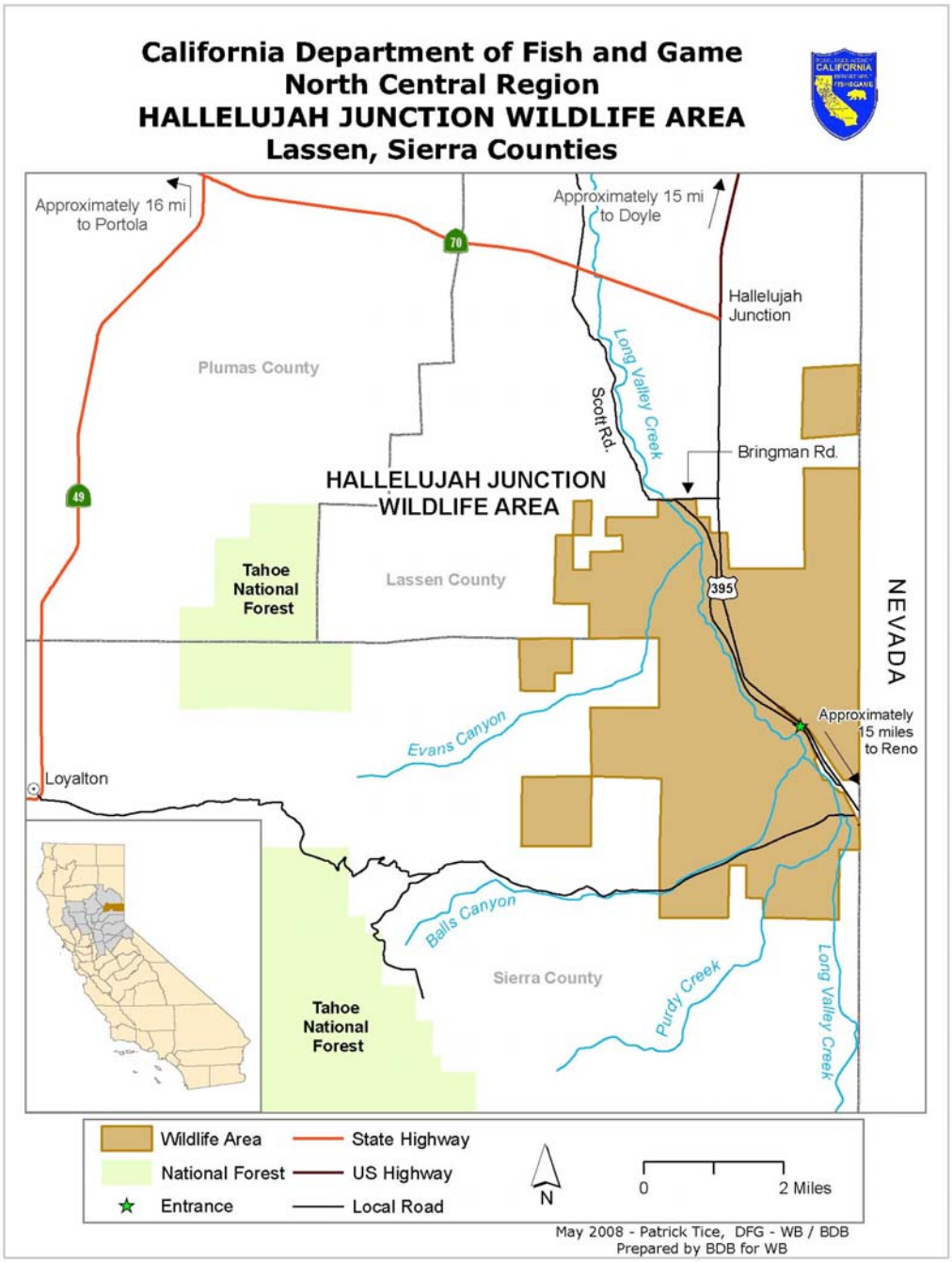
The plan also presents information on approaches, tools, and techniques available for controlling weeds in natural areas, site rehabilitation and restoration, and follow-up monitoring. The strategy presented in this plan must be used as an adaptive strategy, as it will require refinement when additional information about the target species, and about the effectiveness of various treatments, becomes available. This plan is designed to be a stand-alone document; therefore, some information contained in the HJWA LMP is repeated here. Input from the California Department of Fish and Game (CDFG) will be required to finalize this document for use in the field.

1.1 Project Location

Hallelujah Junction Wildlife Area is located at the eastern base of the northern Sierra Nevada in eastern Lassen and Sierra Counties, California. The area encompasses approximately 13,400 acres. It is located south of the community of Hallelujah Junction and between 13 and 20 miles northwest of Reno, Nevada. The Nevada state line forms the eastern boundary of the area. U.S. 395 crosses the area from north to south. Approximately one third of the area is east of Highway 395; the remaining approximately two-thirds is west of the highway (Figure 1). The area encompasses portions of Townships 21 and 22 North, and Ranges 17 and 18 East. Most of the Wildlife Area is on the Evans Canyon USGS 7.5' quadrangle, with one detached parcel at the far northern end (T22N R18E Sec. 19) on the Beckwourth Pass 7.5' quadrangle.

The bulk of the HJWA lies within the broad valley of Upper Long Valley, and slopes gently east or west toward perennial Long Valley Creek. Long Valley Creek flows south to north across the area, west of and closely paralleling U.S.395 except at the far south end of the watershed. On the west, portions of the area extend onto the lower slopes of the Sierra Nevada, and the easternmost portion of the area is occupied by steep north-south ridges that are part of Petersen Mountain. In these areas of the Wildlife Area, slopes are often steep. Two major canyons with perennial streams, Evans Canyon and Balls Canyon, drain the eastern slopes of the Sierra Nevada west of the area. Although the main canyons are mostly outside the boundaries of HJWA, the creeks flow into the area and empty into Long Valley Creek. Evans Canyon Creek enters the area toward the north end of the Wildlife Area, and Balls Canyon Creek enters the area near the southwest corner.

Figure 1. Hallelujah Junction Wildlife Area Location (entrance site corrected by SEI 2009)



2.0 MANAGEMENTAPPROACH AND CONSIDERATIONS

Non-native plant management is a component of an overall comprehensive site management and restoration program as described in the HJWA LMP. CDFG's focus is on promoting the native species and plant communities that are desired on the site, rather than on simply eliminating the undesirable species. In some cases, removing the targeted non-native species will result in colonization by desirable natives, but in many cases, such colonization does not occur without additional restoration work such as soil treatment, seeding, revegetating, transplanting, etc.

It is important to consistently re-evaluate initial goals, objectives and plans so they can be altered or modified as needed. In the long run, this will save time and money, and will reduce the chances of making mistakes. The following list presents a sequence of steps that aid in developing and implementing an adaptive plan:

a) Establish management goals and objectives for the site (see HJWA LMP, Section III).

b) Determine which plant species or populations block, or have potential to block attainment of the management goals and objectives.

c) Identify, document, and map those species or populations, and then assign a priority to these species or to individual occurrences, based on level of threat, feasibility of control, etc.

d) Consider all methods available to eradicate or control targets, or other ways to reduce their adverse impacts; if necessary, re-order priorities.

e) Develop and implement a management plan designed to move conditions toward management goals and objectives.

f) Monitor and assess the effectiveness of management actions in terms of moving conditions toward goals and objectives; and

g) Re-evaluate, modify, and start the cycle again.

It is also very important to implement a prevention program to keep the site free of non-native species that are not yet present, but which are known to be invasive elsewhere in the region. Managers must be particularly aware of species that are not yet on their site, but which occur nearby. The ultimate goal should be to preserve native species, communities and functioning ecosystems; this should be kept in mind when prioritizing efforts and when selecting control methods.

2.1 Rationale for Managing Non-Native Invasive Plants

It is widely recognized that non-native invasive plants (weeds) compete with and displace native plants and animals, and other organisms that depend on these native plants for food and shelter. They can alter ecosystem functions and cycles, hybridize with native species, and promote other non-native or undesirable species. Some species are known to increase the frequency and intensity of wildfire, damaging the ecosystems ability to restore itself through succession. Many plant invasions can be stopped, slowed, or even reversed. In certain situations, even badly infested areas

can be restored to healthy systems dominated by native species. In most cases this requires taking action to control and manage the invasive plants.

2.2 Data and Maps of Target Species Occurrences

Maps of the extent of species occurrences and estimates of density or cover are essential for a successful program. Maps and data on existing conditions will be used as a baseline (standard) for measuring success of control or removal efforts. Such information also facilitates cooperative efforts with adjacent land owners/managers. If and when herbicides are used, maps and density data will facilitate development of application rates. The initial cost of mapping can be high; however, if land managers work cooperatively with the regional Weed Management Area (WMA) group, the costs can be shared. Mapping is also needed for the California Environmental Quality Act (CEQA) compliance process.

Mapping and documentation of species that are anticipated to be the targeted highest priority species should be conducted first. A preliminary list of such species is presented in Section 3.3.

2.3 Prioritizing Species for Management

It is critical to set priorities for non-native invasive plant management actions. Managers must identify the highest priority species occurring on their land, and in many cases, the highest priority occurrences within species. In some cases, a no action alternative should be considered, such as when more damage would occur to native species and habitats by applying control methods than by maintaining the status quo. Setting priorities will ensure that resources available for non-native plant management are spent most effectively.

There are a number of systems in use for prioritizing removal and management efforts. The first step is to determine the level of threat posed by the invasive non-native species identified. This information can be obtained from lists maintained by the California Department of Food and Agriculture (CDFA 2008), by the California Invasive Plant Council (Cal-IPC 2006), and others. The CDFA list initially was prioritized based on threats to agricultural crop lands, but the list now incorporates threats to native habitats in California. The list uses an A-D rating system: A is the highest priority for eradication and D is of lower priority. Cal-IPC provides a list of invasive plant species occurring in California, as well as assessments of potential invasiveness and other basic information. Bossard et al. (2000) provide additional, detailed information about invasive plants in California. See Appendix 1 in this document for a list of additional resources on non-native plant management and prioritization.

Once the existing information on the species has been assessed, managers need to evaluate several other site-specific elements before establishing their priorities for treatment. Elements to consider include the following:

- **Extent of Infestations.** Small, incipient occurrences (new populations or outliers of larger infestations) of species posing a high level of threat would usually be high priority. Species present in large infestations that continue to expand would be a medium priority, and species present in large infestations that are not expanding would generally be lower.

- **Current and Potential Impacts of the Infestations.** For example, if the infestation is immediately threatening rare plants or their habitat, it would likely be high priority.
- **Ecological Value of Habitats or Areas that are Infested or May Become Infested.** Infestations that occur in the most highly valued habitats or areas, such as wetlands, areas with rare or highly valued species or communities, and areas that provide vital resources would be of highest priority; infestations in less highly valued portions of the site would be intermediate; and areas already badly infested with other invasive non-natives may be a lower priority, unless the species in question will make the situation significantly worse. Also consider threats to ecosystem parameters such as soil integrity, which can be changed by certain non-native species.
- **Feasibility of Success.** It is important to realistically consider the difficulty and cost of control, as well as establishment of replacement species. Clearly, highest priority would be given, in most cases, to species or occurrences likely to be controlled or eliminated with available technology and resources, and to sites that will be re-colonized by desirable native species with little further input. Lower priority would be given to species or occurrences that are likely to be controlled, but will not be replaced by desirable natives without an active restoration program. Species or occurrences that are difficult to control and/or whose control would likely result in substantial damage to desirable species, would be given even lower priority.

3.0 INVENTORY AND ASSESSMENT OF INVASIVE NON-NATIVE PLANTS

Baseline reconnaissance-level botanical surveys were conducted on July 29, 2007 and May 14- 26, 2008 (Sustain Environmental Inc., unpublished report). The surveys were conducted to fulfill the following objectives:

1) To characterize and map the habitat types (plant communities) of the HJWA; and
2) To compile a partial floristic list of vascular plant species occurring in the HJWA; and
3) To, as time permitted, survey for special-status plant species.

The Hallelujah Junction Wildlife Area LMP details the methods and results of this survey effort (III). The results of the botanical survey should be considered preliminary as time constraints precluded compiling a complete floristic list or conducting an exhaustive special-status plant survey. Data from these surveys were used in preparation of this weed management plan.

3.1 Summary of Vegetation in the Wildlife Area

Based upon the preliminary assessment, a total of 180 species of vascular plants were identified in the HJWA. Of these, 146 are native and 32 are non-native or naturalized. It is uncertain whether two species occurring in the area, common watercress (*Rorippa nasturtium-aquaticum*) and Kentucky bluegrass (*Poa pratensis*), are native or non-native based on differing descriptions by Munz and Keck (1973) and Hickman (1993). Additional surveys are recommended, to be conducted at intervals throughout the growing season, to develop a comprehensive species list.

There were eight primary habitat types found at HJWA. Table 1 presents a summary of the communities present and a crosswalk between the Holland (1986) and Sawyer and Keeler-Wolf (1995) plant community descriptions.

Table 1. Crosswalk of Plant Community Types, Hallelujah Junction Wildlife Area

HJWA Plant Community Types	Total Acres	CDFG 2003, Holland Habitat Types [1]	Sawyer/Keeler-Wolfe Habitat Series [2]
Big sagebrush scrub	6598	Great Basin scrubs (35000) Great Basin mixed scrub (35100) Big sagebrush scrub (35210) Sagebrush steppe (35300)	Big sagebrush series
Low sagebrush scrub	263	Low sagebrush dwarf scrub (35.120.00)	Black sagebrush series Low sagebrush series
Mountain mahogany scrub	125	Curlleaf mountain mahogany woodland and scrub (CDFG 2003) Broadleafed upland forest (81000)	Curlleaf mountain mahogany series
Interior-rose golden-currant big-sagebrush scrub	4	Great Basin mixed scrub (35100)	__
Spineless-horsebrush/herbs	175	__	__
Juniper woodland	861	Utah juniper woodland (CDFG 2003) Great Basin juniper woodland and scrub	Utah juniper series
Jeffery pine forest	93	Jeffery pine forest and woodland (CDFG 2003) Jeffery pine forest (85100)	Jeffrey pine series
Jeffrey pine woodland	215	Jeffery pine forest and woodland (CDFG 2003)	Jeffrey pine series
Riparian scrub	134	Low to high elevation riparian scrub (CDFG 2003) Pacific willow riparian forest (CDFG 2003) Montane riparian scrub (63500)	Montane wetland shrub habitat
Riparian forest/scrub	28	Montane black cottonwood riparian (61530), Modoc-Great Basin cottonwood-willow riparian forest (61610) Montane riparian scrub (63500) Modoc-Great Basin riparian scrub (63600)	Black cottonwood and mixed willow series
Meadow (dry to wet)	926	Montane meadow alliance (CDFG 2003) Great Basin Grassland (43000) Wet Montane Meadow (45110) Dry Montane meadow (45120)	Montane meadow habitat Nebraska sedge series
Spring	1	Meadows and seeps (CDFG 2003) Wet Montane Meadow (45110)	Montane meadow habitat Nebraska sedge series
Recent burns	3964	__	Cheatgrass series
Developed	7	__	__

[1] CDFG 2003, Holland 1986
[2] Sawyer and Keeler-Wolf 1995, (pending publication of Sawyer, Keeler-Wolf and Evens 2009)

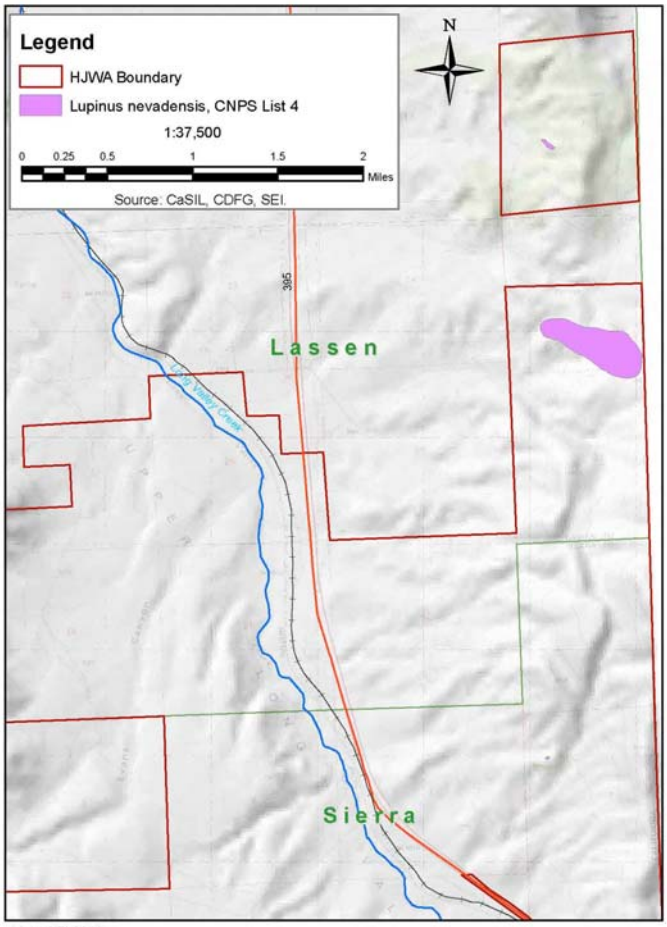
3.2 Special-Status Plants

Documenting the locations of special-status plants, prior to managing non-native plants, is critical in order to avoid causing direct or indirect (e.g., herbicide drift) harm. According to CNDDB records (CDFG 2008) and CNPS Inventory records (Tibor 2001, CNPS 2008), four special-status plant species that are legally protected under CEQA, have known occurrences within, or very near the boundaries of, the HJWA. They are:

- purple milk-vetch (*Astragalus agrestis*),
- Nevada daisy (*Erigeron nevadincola*),
- Webber's ivesia (*Ivesia webberi*), and
- golden violet (*Viola aurea*).

One special-status plant species, Nevada lupine (*Lupinus nevadensis*), was observed in the survey area. Nevada lupine is on List 4 (Plants of limited distribution) of the CNPS Inventory (Tibor 2001, CNPS 2008), and therefore does not fall under any specific legal authority. This species occurs locally in juniper woodland and big sagebrush scrub in the extreme northeastern portion of the survey area (Figure 2).

Figure 2. *Lupinus nevadensis* locations at Hallelujah Junction Wildlife Area



No other populations of special-status plants were observed during the 2007/2008 surveys, but additional surveys are recommended, timed to match the phenology of the species to document plant occurrences. Table 2 presents the known locations of special-status plants on or near the HJWA.

Table 2. California Natural Diversity Database (CNDDB) locations for special-status plant species[1] on or immediately adjacent to the Hallelujah Junction Wildlife Area

CNDDB Occurrence #	Location (Township, Range, Section)	Notes
Purple milk-vetch (Astragalus agrestis)		
1	T21N R18E Sec. 30	Just outside Wildlife Area boundary
Nevada daisy (Erigeron nevadincola)		
4	T22N R17E Secs. 25, 36	
5	T21N R18E Sec. 6	
6	T21N R17E Sec. 4	
7	T21N R17E Sec. 2	Within Balls Canyon fire area
8	T21N R18E Sec. 7	
9	T21N R17E Sec. 4	
10	T21N R18E Sec. 7	
11	T21N R18E Sec. 18	
12	T21N R17E Sec. 13	
13	T21N R18E Sec. 30	Just outside Wildlife Area boundary
28	T21N R17E Sec 1	
Webber's ivesia (Ivesia webberi)		
8	T21N R17E Sec. 11	Within Balls Canyon fire area. Mapped location searched 5/08, species not observed
10	T22N R17E Sec. 36	Just inside Wildlife Area boundary
Golden violet (Viola aurea)		
6	T21N R17E Sec. 12	Along U.S.395
7	T21N R17E Sec. 1 and T22N R17E Sec. 36	

[1] CDFG 2003

3.3 Preliminary List of High Priority Invasive Plant Species

This section should be considered preliminary, a first effort based on the baseline inventory for the LMP (Section III). Development of a fully prioritized weed management plan is beyond the scope of this effort because additional data collection, mapping, and internal decision-making must occur before priorities can be firmly established. The following priority list is based on Cal-IPC's Invasive Plant Inventory (2006), which categorizes non-native invasive plants that threaten the state's wildlands. Categorization is based on an assessment of the ecological impacts of each plant. This inventory represents the best available knowledge of invasive plant experts in the state. To quote Cal-IPC:

> "The Inventory categorizes plants as High, Moderate, or Limited, reflecting the level of each species' negative ecological impact in California. Other factors, such as economic impact or difficulty of management, are not included in the assessment. It is important to note that even Limited species are invasive and should be of concern to land managers. Although the impact of each plant varies regionally, its rating represents cumulative impacts statewide. Therefore, a plant whose statewide impacts are categorized as Limited may have more severe impacts in a particular region. Conversely, a plant categorized as having a High cumulative impact across California may have very little impact in some regions."

Table 3 shows a preliminary list of the invasive species likely to be of highest priority for management. The assessment that led to the development of this table included information from Cal-IPC and our best professional judgment.

Table 3. High-priority invasive plants at Hallelujah Junction Wildlife Area

Common Name	Scientific Name	Cal IPC Inventory Rating[1]	Impacts	Invasiveness	Distribution	Ecological types invaded and comments	State[2]
Cheatgrass	Bromus tectorum	High	A	B	A	Interior scrub, woodlands, grasslands. Most widely distributed invasive plant in the US.	None
Perennial pepperweed	Lepidium latifolium	High	A	A	A	Coastal and inland marshes, riparian areas, wetlands, grasslands. Has potential to invade montane wetlands.	B noxious weed list
Hairy whitetop	Cardaria pubescens	Limited	C	B	C	Grasslands and meadows. Impacts unknown but may be significant in meadows of Cascade Range.	B noxious weed list

[1] Cal-IPC rating: Scores A = severe, B = moderate, C = limited.
Accessed online: http://www.cal-ipc.org/ip/inventory/pdf/Inventory2006.pdf
[2] USDA PLANTS Database; http://plants.usda.gov/java/noxComposite

3.4 Non-Native Invasive Plants

A list of the non-native plant taxa identified to date is included in Appendix 2 of this document. Distribution of these taxa within the various habitat types of the Wildlife Area is described in the HJWA LMP (III). Three invasive species are considered a management priority for treatment in this plan:

1) Cheatgrass (*Bromus tectorum*),
2) Perennial pepperweed (*Lepidium latifolium*) and
3) Hairy whitetop (*Cardaria pubescens*).

Additional surveys and detailed mapping of occurrences of these priority species may be necessary prior to treatment. This will provide the baseline for follow-up monitoring and facilitate analysis of treatment effectiveness. The following section summarizes the high priority invasive species (see Appendices 3 - 5 for additional information).

1. Cheatgrass

Cheatgrass *(Bromus tectorum)* is a winter or spring annual grass that produces nodding, open panicles. This species usually germinates in the fall or winter. When temperatures increase in the spring it grows quickly, often maturing and setting seed before most other grass species. At maturity during the late spring and early summer the foliage and seedheads take on a slight purple color before drying out completely and becoming brown. This species reproduces by seed only and control efforts must target the seed producing stage of plant growth in order to be successful.

Cheatgrass is the most extensive invasive species on the HJWA and is widespread throughout California. It is the dominant annual grass on sagebrush (*Artemisia* sp.) rangelands on the Modoc Plateau in northeastern California and along the eastern Sierra Nevada to Owens Valley. In wildlands it is most commonly found in sagebrush/bunchgrass communities, although its distribution extends to higher elevation juniper, pinyon-juniper, and pine woodlands.

Cheatgrass displaces native vegetation and triumphs over the seedlings of native and desirable species for soil moisture. It has been determined that cheatgrass also interferes with seedling establishment of shrubs such as antelope bitterbrush (*Purshia tridentada)* and with pine (*Pinus* sp.) transplants. Cheatgrass changes the frequency, extent, and timing of wildfires by creating a continuous fuel load between otherwise widely spaced shrubs, such as bitterbrush and sagebrush. Cheatgrass matures and dries early in the season and the increased fuel load in turn increases the frequency of fires. Areas disturbed by fire are readily colonized by cheat grass, continuing the cycle of cheatgrass establishment. With the colonization of cheatgrass in the Great Basin rangelands, fire frequency has changed from 60 to 100 years to 3 to5 years (Whisenant 1989), precluding the reestablishment of desirable shrub species, such as bitterbrush, after a fire.

2. Perennial pepperweed

Perennial pepperweed *(Lepidium latifolium)* is a perennial, multi-stemmed herb that grows three to eight feet tall. The stems and leaves of this plant are glabrous, dull gray-green and waxy, with occasional reddish spots. White flowers are produced in dense clusters at the tops of the stems from May to July, producing many small light brown fruits during June and July. Perennial pepperweed can reproduce from seed as well as from segments of the root system. Seeds usually germinate in the spring in wet sand or mud.

Perennial pepperweed invades brackish to saline or alkaline wetlands throughout California, from the coast to the interior and north and eastward into the Great Basin and Columbia Basin. It is an aggressive invader of agricultural and wetland areas in the Central Valley and east of the Sierra Nevada. Perennial pepperweed forms dense monospecific stands that exclude other plants, including natives. In waterfowl nesting areas it out-competes grasses that provide food for waterfowl. In Lassen County it has become widely established in native hay meadows, reducing the value of the hay crop (Bossard et al 2000). Perennial pepperweed has high concentrations in the riparian scrub habitat occurring along Long Valley Creek, the hay meadow, and along the roadways up into Balls Canyon (J. Dawson, CDFG, personal communication).

3. Hairy whitetop

Hairy whitetop (*Cardaria pubescens)*, also known as globe-podded hoary cress, is a perennial (family Brassicaceae) that develops an extensive system of deep vertical and horizontal roots that

vigorously produce new shoots. It can reproduce by root fragments or by seed. It produces white flat-topped inflorescences from May to June producing small pods containing seeds. The seeds germinate in the fall usually after the first rains and over winter as a rosette.

This plant is scattered throughout California, but is most frequently seen in the Sacramento Valley, Great Basin, and southwestern region of the state (Cal-IPC 2006). At HJWA, hairy whitetop was identified in the extreme southern portion of the Wildlife Area, in the interior-rose golden-currant sub-habitat type.

Hairy whitetop tolerates a wide range of soil types and moisture conditions. It persists under a wide range of environmental conditions and is found in irrigated croplands, roadsides, rangelands, and wildland areas. The plants are also found in riparian-upland ecotones and are somewhat salt and alkaline tolerant, but generally not shade tolerant. Hairy whitetop readily establishes in disturbed areas in range and wildlands and is favored during years of above average precipitation. Its invasion potential is greater under heavily grazed conditions or other disturbances. Infestations rapidly establish dense stands and may exclude native species, reduce biodiversity and decrease rangeland productivity and forage quality. In agricultural areas, they are most aggressive in irrigated fields and in areas where cultivation is infrequent (CDFA 2008).

4.0 CONSIDERATIONS FOR SPECIES-SPECIFIC MANAGEMENT STRATEGIES

Management strategies for non-native invasive plants must be species-specific, and sometimes specific to individual occurrences. For example, on some occurrences it may be safe to use herbicides, but other occurrences may be too close to water or rare species.

This section provides general information on techniques that can be used to control or eradicate some of the high priority species (Table 3). Site managers will need to collect additional information on specific locations of infestations before treatment protocols can be finalized.

All pesticide applications made on department-managed lands or for department-managed projects must first be approved by the department's pesticide use coordinator, a pest control adviser licensed by the California Department of Pesticide Regulation (DPR) and assigned to the department's Pesticide Investigations Unit (PIU) (CDPR 2006). CDFG's Pesticide Investigation Unit focuses on five general categories of pesticide work: (1) Incident investigations involving fish and wildlife and pesticides; (2) Hazard assessments of pesticides to fish and wildlife resources; (3) Protection of threatened and endangered species with regards to the use of pesticides; (4) Assessment of pest control and eradication programs on fish and wildlife resource; and (5) Coordination and approval of Department pesticide uses and training of CDFG personnel. PIU staff works closely with Department of Food and Agriculture, Department of Pesticide Regulations, and County Agriculture Commissioner staffs (CDFG 2009). Requests to use pesticides must be submitted to the PIU on the department's pesticide use request form (FG-880) at least 30 days before the intended use date. No pesticide applications can be made to department-managed lands without an approved FG-880 from the PIU. Copies of approved FG-880s must be maintained by department pesticide applicators for at least two years after the pesticide application date. This requirement does not apply to the control of indoor and landscape pests associated with department-managed buildings.

Except as indicated below, all pesticide applications made on department-managed lands or for department-managed projects must be supervised by department personnel who have obtained their qualified applicator certificate from the DPR.

Exceptions to this requirement include the following situations:

1) indoor and landscape pest control at department-managed facilities,
2) pesticide applications made by DPR-licensed commercial pest control companies, vector control districts, or similar agencies, and
3) pesticide applications made by farmers to crops grown under lease agreements with the department.

Herbicides and pesticides are considered hazardous materials and even with the best of care, accidents do occasionally happen. Appendix 6 of this document contains contact information concerning local medical treatment facilities. This information should be kept up to date by HJWA area managers.

4.1 Basic Treatment Options

The following list presents the basic menu of treatment options available for land managers for removing or slowing spread of non-native plants. They can be used separately or in combination:

- prevention of spread by stopping ongoing soil disturbance,
- manual removal (hand pulling),
- mechanical removal (mowing, weed-whacking),
- controlled grazing (cattle, sheep or goats),
- prescribed fire or scorching,
- herbicide application, and
- revegetation with natives.

4.2 Treatment Options for Highest Priority Species

The following sections provide some of the available treatment options for the highest priority species on HJWA lands (Table 3). Much of this information is derived from the California Invasive Plant Council (2006) and Erskine-Ogden et al. (2007). Additional management information on these species has been provided to CDFG Area Managers.

4. Cheatgrass

1) Tilling in the spring after cheatgrass is established can be effective if sufficient moisture is present to support perennial seedling establishment.
2) Grazing in late fall or early spring before seed set has shown significantly reduced plant numbers (heavy grazing will promote cheatgrass invasion).
3) Herbicide spraying has been shown to be effective against cheatgrass but many types cannot be used around streams and rivers.

4) Burning in late May or early June is an option after plants have died to help remove the seed bank, but then the site should immediately be drill seeded with native perennial grasses (Carpenter and Murray 2000)

5) A two to three-year combination of burning, herbicide application, and reseeding can be used to control and re-vegetate an area that is almost exclusively dominated by cheatgrass. Burn and re-seed the area with native perennial grasses during the first year. The following spring, apply herbicides before the seeded perennial grasses emerge in order to eliminate any cheatgrass that emerged from the seedbank after the burn. If necessary, apply a second round of herbicides early in the spring of the third year to control any new cheatgrass seedlings and provide time for native bunchgrasses to establish. This should control the cheatgrass, deplete the existing cheatgrass seed bank, and provide adequate time for perennial grasses to establish to the point where they can suppress any new cheatgrass invasions (ibid.).

5. Perennial pepperweed

1) Hand pulling is feasible only for seedlings. Established plants have a continuous mass of deep, interconnected roots that frequently break. Each segment can vegetatively reproduce, making it critical to grub out as much of the root system as possible.

2) Mechanical removal is not recommended given the plant's ability to spread easily from root fragments, but it will temporarily stop seed from spreading.

3) It may be possible to cut this plant back prior to flowering, and then cover the root system with cardboard or landscape fabric for a year to reduce the plant's ability to resprout.

4) An early season mowing has been shown to dramatically shift the total leaf area and the location of the leaf area within the plant canopy. Resprouting stems had 21-59% less leaf area than plants not mowed at the flowerbud stage. In mowed areas, 84-86% of the leaf area was found within the lower third of the canopy. If herbicide applications are made to resprouted shoots, more herbicide will be deposited onto the lower third of the canopy. This may in turn lead to the translocation and accumulation of more herbicide to below-ground perennial organs, enhancing control (Renz 2000).

5) The optimal timing for herbicide applications is the flowerbud stage. In riparian or wetland habitat, use a product that is not toxic to aquatic organisms and apply with a wick-type applicator to prevent herbicide drift.

6) Sheep and goats will graze on perennial pepperweed if the leaves are still young and there is nothing else to eat.

7) Keep roots away from waterways to minimize further infestations downstream. Wash equipment and the tires and undersides of vehicles after leaving the site.

8) Bag and dispose of pulled plants as household garbage or take them to a green waste facility. Alternatively, dispose of the plants through hot compost with grinding (but not ordinary compost, as very small fragments will reroot).

9) Any revegetation should be carried out as soon as possible. Natives with creeping perennial roots may be best.

10) Follow-up: Regular follow-up is essential as roots can lay dormant underground for several years. Return to the site in early spring and late summer for several years to check for regrowth and to remove rosettes. Scrape litter from the soil surface to allow other species to grow. Soil remediation may be required before planting native species.

6. Hairy whitetop/globe-podded hoary cress

1) Where physical conditions permit, hoeing at intervals of 3 to 4 weeks (depending on rate of regrowth) may be as effective as cultivation for eradication of hoary cress. Stands of globe-podded hoary cress have been eradicated in 1.5 to 2 seasons by hoeing at intervals of four weeks. Soils must remain moist between hoeing so that plants can regrow and deplete their root reserves (Lyons 2000).

2) Herbicides are effective in gaining initial control of new or severe infestations, but are rarely a complete or long-term solution to invasive species management (Zouhar 2004).

3) Effective management of hoary cress requires an integrated approach that includes 1) containment of known infestations; 2) prevention to assure new sites are not invaded; and 3) control to reduce or eliminate known infestations (ibid.).

4) Manage rangelands for plant communities in which all niches are occupied by vigorous plants. Grazing management plans consisting of moderate forage utilization and seasonal rotation of livestock can help desirable perennial plants maintain vigor and competitive ability and minimize hoary cress establishment and spread (ibid.).

5) Livestock should not be permitted to graze weed-infested areas during flowering and seedset. If animals do graze infested areas during and after seed production, they should be transported to a holding area for 10 to 14 days, to allow time to digest and excrete seeds, before moving to uninfested areas (ibid.).

6) Herbicides are more effective on large infestations when incorporated into long-term management plans that include replacement of weeds with desirable species, careful land use management, and prevention of new infestations (ibid.).

5.0 FOLLOW-UP MONITORING FOR TREATMENT EFFECTIVENESS

Follow-up monitoring to determine the effectiveness of treatments is a critical component of a successful non-native plant management program. Monitoring is valuable for providing information on the following:

1) progress of removal efforts,

2) effectiveness of treatments,

3) degree of re-establishment of target species after removal treatments have been applied (i.e., presence of seedlings or re-sprouts),

4) length of time follow-up visits are necessary,

5) status of natural or imposed re-vegetation on treated sites (e.g., the proportion of native vs. non-native plants re-colonizing the area), and

6) use of the treated area by native wildlife.

Monitoring and documentation also are valuable for determining costs of plant management programs, for reporting on the use of project funding, and for information exchange with other land managers dealing with similar species.

Monitoring can be done using a variety of methods, either qualitative or quantitative. Selection of methods will be contingent on the specific objectives and on available funding, and therefore should be prioritized as removal and control efforts are prioritized. The following information on examples of low, moderate, and high intensity monitoring are excerpted from Center for Invasive Plant Management (CIPM) (Appendix 1):

Low Intensity (Level I)

Objective: To detect new infestations and to assess the success of small scale chemical or mechanical control programs.

1) Annually survey size and density of weed infestations and vegetation trends.
2) Assemble data on past and current weed control activities within the WMA.
3) Annually update distribution/density map.
4) Annually examine areas that are determined to be particularly susceptible to weed infestations.

Moderate Intensity (Level II)

Objective: Assess the success of ongoing chemical, biological control, or prevention programs in order to evaluate the need for adjustments.

Include the elements of Level I, plus:

1) Establish permanent transects to aid visual monitoring.
2) Establish photo points. Catalog and store photos so they are useful for recording trends.
3) Collect weather data. This will require access to weather records and Palmer Drought Index (NOAA 2008).
4) Evaluate the success of public education programs.
5) Monitor funding from various sources.
6) Assess the prevention effort.
7) Compare the success of application timing, rates, and methods of treatment with that of applications on similar areas.
8) Make an annual visual inspection for symptoms of damage to desirable plants.
9) Make post-treatment inspections to determine possible damage and the need for retreatment.

High Intensity (Level III)

Objective: Assess the success of major, sensitive or experimental control programs.

Include the elements of Levels I and II, plus:

1) This level may require the use of statistical and chemical analysis.
2) Establish a computerized database. Geological Information Systems (GIS) lend themselves to this level of monitoring.
3) Automatic weather stations may be used to collect data.
4) May require more detailed maps.
5) Collect data on ground water, soils, health effects and impacts on wildlife management.

Also note that weed-free areas also deserve rigorous monitoring. Preventing weeds from becoming established is the most effective, economical, and ecologically sound approach to managing invasive plants at the Hallelujah Junction Wildlife Area.

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Appendix 1: Additional Resources

Developing a Weed Management Plan

Adaptive Weed Management Plan Template. The Nature Conservancy. A three-part tool: (1) An introduction to the philosophy of adaptive management, (2) weed management plan template, including boiler-plate language to ease the planning process and help prioritize weeds, and (3) Excel workbook to keep track of your work and costs.

Weed Information Management System (WIMS). The Nature Conservancy. WIMS keeps track of weed occurrences (GPS point locations), assessments (size and status of the weed infestation to facilitate monitoring over time), and management treatments applied to those weed infestations.

The Colorado Natural Areas Program. 2000. Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values. *In* Caring for the Land Series, vol. 4, Colorado State Parks, Colorado Department of Natural Resources. Provides the tools and information necessary for public and private landowners to manage noxious weeds successfully in natural areas, wildlands, and rangelands.

Seven Steps to Managing Your Weeds: A Manual for Integrated Management in British Columbia. 2002. Open Learning Agency and British Columbia Ministry of Agriculture, Food and Fisheries. Burnaby, British Columbia, Canada.

Prioritizing Weed Threats

Criteria System. Cal-IPC 2006 Invasive Plant Inventory. For categorizing invasive non-native plants that threaten wildlands.

Evaluating Risk to Native Plant Communities from Selected Exotic Plant Species. U.S. Forest Service. Developed to help land managers identify the native plant communities most threatened by invasive plants.

Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. NatureServe, Arlington, VA. The protocol is designed to make the process of assessing and listing invasive plants objective, systematic, and transparent and will help set priorities focusing scarce management resources.

Stohlgren, T J. 2006. Measuring Plant Diversity: Lessons from the Field. Oxford University Press, New York, NY. Because resident native diversity can affect the likelihood of invasion by non-native plants, it is critical that scientists accurately assess the composition of plant communities over large areas.

Inventory and Survey

California Weed Mapping Handbook. Provides information on (1) shared data standards, so that different data sets will be compatible, and (2) "how to" instructional information on mapping techniques. Its aim is to help those working on weed issues to develop mapping systems that will support project goals on both a local and state level. PDF (2 MB) download on Web site.

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Map Important Weeds for a Living Inventory, part 3. Nevada's War on Weeds, University of Nevada Cooperative Extension, Reno.

Mapping Standards from NAWMA. North American Weed Management Association, Meade, KS.

Photo Point Monitoring: How Can I Monitor without Spending a Lot of Time and Money? USDA Forest Service, Remote Sensing Applications Center, Salt Lake City, UT.

Remote sensing… and invasive species. The Global Invasive Species Team, Nature Conservancy. An introduction intended to help land managers decide if remote sensing could be a useful tool for them.

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Weed Manager's Guide to Remote Sensing and GIS. USDA Forest Service, Salt Lake City, UT.

Appendix 2: Partial List of Non-Native Vascular Plant Species[1] Observed in the Hallelujah Junction Wildlife Area, Lassen and Sierra Counties, CA

Name	Common Name	Invasiveness Ranking[2]
ASTERACEAE		
Carduus nutans	Musk thistle or nodding thistle	B
Cirsium vulgare	Bull thistle	B
Lactuca serriola	Prickly lettuce	D
BRASSICACEAE		
Capsella bursa-pastoris	Shepard's purse	-
Cardaria pubescens	Hairy whitetop, hoary cress	B
Descurainia sophia	Flix weed, Tansy mustard	B
Lepidium latifolium	Perennial pepperweed	A
Lepidium perfoliatum	Clasping pepperweed	-
Rorippa nasturtium-aquaticum (?)[3]	Common watercress	-
Sisymbrium altissimum	Tall tumblemustard	-
CHENOPODIACEAE		
Atriplex rosea	Tumbling saltweed	-
Chenopodium botrys	Jerusalem oak goosefoot	-
CONVOLVULACEAE		
Convolvulus arvensis	Field bindweed	B
FABACEAE		
Medicago lupulina	Black medick	-
Melilotus officinalis	Yellow sweet clover	C
Robinia pseudoacacia	Black locust	B
Trifolium repens	White clover	-
LAMIACEAE		
Mentha spicata var. *spicata*	Spearmint	-
PLANTAGINACEAE		
Plantago lanceolata	Narrow leaf, English plantain	C
Plantago major	Common plantain	-
POLYGONACEAE		
Rumex acetosella	Common sheep sorrel	
Rumex crispus	Curly dock	C
ROSACEAE		
Rubus laciniatus	Cutleaf blackberry	-
SCROPHULARIACEAE		
Verbascum thapsus	Great or common mullein	-
ULMACEAE		
Ulmus sp.	Elm	-
POACEAE		
Agropyron desertorum	Desert crested wheatgrass	-
Agrostis stolonifera	Creeping bentgrass	-
Bromus inermis ssp. *inermis*	Smooth brome	-
Bromus tectorum	Cheatgrass	-
Crypsis schoenoides	Swamp picklegrass, swamp grass	-
Festuca pratensis	Meadow fescue	-
Phleum pratense	Timothy grass	-
Poa bulbosa	Bulbous blue grass	-
Poa pratensis (?)	Kentucky bluegrass	B

[1] Cal-IPC 2006.
[2] Cal-IPC Invasiveness Rating:
A = Severe, B = Moderate, C = Limited, D = None, U = Unknown
[3] May be naturalized.

Appendix 3: Emergency Medical Facilities

The nearest hospitals and medical clinics are located in Reno and Sparks, Nevada.

Saint Mary's Regional Medical Center

235 West Sixth Street
Reno, Nevada 89503
(775) 770-3000

Saint Mary's Urgent Care on McCarran

6770 S. McCarran Blvd.,
Reno, Nevada 89519
(775) 770-3254

Renown Urgent Care

910 Vista Boulevard [map | driving directions]
Corner of Vista Blvd. and Prater Way
Sparks, NV 89434
(775) 982-4580

1155 West 4th Street, Suite 108 [map | driving directions]
Near Keystone Avenue
Reno, NV 89503